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ABSTRACT

Although effective schools research argues that careful monitoring, analysis, and discussion of student progress and program quality are central to improving education, educators' efforts are limited by the dispersion of student data throughout district files. The Instructional Decision Support System, used in a cooperative venture involving the Wissahickon School District (Pennsylvania) and the University of Pennsylvania Graduate School of Education, was designed to develop more effective inquiry strategies for understanding the relationship between achievement and demographic variables and their effects on student achievement. Because the traditional reliance on "measures of the average" hides more than it reveals, the project attempts to help administrators and teachers go beyond averages, rates, and percentages to evaluate both student progress and educational program effectiveness. By enabling educators to disaggregate individual experience from the total population, it is possible to understand how district initiatives affect individual students or subgroups. The project developed "display analysis" techniques for graphically depicting one or more variables for a target population. The displays allow educators to analyze the fit between programs, student population, and various subgroups. Further analysis can then occur using additional data, including staff's personal knowledge about students. (MLH)

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SCHOOL/UNIVERSITY PARTNERSHIPS

WISSAHICKON SCHOOL DISTRICT
AND THE
UNIVERSITY OF PENNSYLVANIA
GRADUATE SCHOOL OF EDUCATION

INSTRUCTIONAL DECISION SUPPORT SYSTEM

PRESENTED AT
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Close attention to student progress is an important component of school improvement activities. Like any bureaucracy, school districts collect a great deal of information about student characteristics and performance. This data is scattered around the district in a variety of pencil and paper and computerized formats. Some of this data finds its way into reports to the board, or state and federal education agencies. However, the data and the reports based on that data are only infrequently available in a form that allows teachers and administrators to understand district programs, student progress, or student experiences in the district.

Yet there is an expectation that data readily available in a flexible format can provide useful insight into student educational experiences. The question is how to use the data districts normally collect as a flexible "database," that is easy to manipulate so that some data could be explored while other data are ignored, or explored by comparing variables from different sources.

Over the last three years, we have developed an individual student database built on demographic, achievement, and student attitude and classroom process variables. This database is a flexible way of storing, organizing, and retrieving information on individual students that educators themselves find useful in their work and making decisions about how to improve their impact on student learning. The prototype of this database is currently being used on a limited basis by staff in the district.

The prototype was developed to meet several criteria drawn from management information system, office automation, and information science research:

- the information is provided in a time and form which fits users work situations;
- the information system is well-integrated into their work settings so they will use it;
- the system is flexible so that information can be retrieved in a variety of forms and in combination with any other information in the system;
- the system is designed so users can easily add categories of data as their needs and interests dictate.

We began with data the district currently collects, acknowledging that data currently being collected might not be the data they ought to be collecting. We realized that we would get a better sense of what data we ought to collect once we began to work with data already collected and discovered what else was needed.

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PILOT PROJECT

The purpose of the pilot project was to develop a prototype longitudinal student database and to test the feasibility of that database as an effective and efficient means to disaggregate data connected to achievement, demographic variables, and related student experience. This database consists of demographic and achievement variables. Demographic variables included student name, student number, sex, race, age, and special program participation. Achievement variables included grades and grade point averages, scores on district-administered reading tests, scores on standardized achievement tests (Metropolitan Achievement Test), and scores on standardized aptitude tests (Scholastic Aptitude Test).

The results of the pilot project encouraged us to expand our efforts. Several Wissahickon School District staff have demonstrated that the database can provide them with information which makes them more effective and efficient. In addition, these staff have shown that they can develop new instructional indicators which increase understanding of the instructional process. Other Critical Success Factors include management support and interest in the upper and middle ranks, a well-functioning information system, availability of longitudinal data, and a district size which provides breadth of experience but not so large as to make database development an overwhelming task.

The pilot project clearly demonstrated the feasibility of developing a longitudinal student database that would allow educators to disaggregate from summary statistics to look at particular subgroups of students. In addition, it demonstrated that disaggregation could provide powerful insights into student achievement and educational experience. We discovered, for example, a subgroup of students with high grade point averages who didn't score as expected on standardized tests. This led us to look for similarities among those students, so we might develop interventions appropriate to their needs.

The graphic representations that were generated using student data provided new and unique opportunities for administrators to study student experience. Well accepted "rules" about the predictability of achievement were shown not to hold true for students in the district. Consequently, eductors were compelled to formulate new and better questions about district programs and student achievement. The greatest promise offered by the pilot project is that we are capable of using existing data, in new combinations, to answer questions that previously could not be asked.

Importance of the Project

The Instructional Decision Support System is designed to enable educators to develop more effective inquiry strategies to understand the relationship of achievement and demographic variables and their impact on student achievement in the Wissahickon School District. Because the traditional reliance on "measures of the average" hides more than it reveals, the project is designed to develop ways for administrators and teachers to go

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beyond reporting average scores of student progress. By enabling educators to disaggregate individual experience from the total population it is possible to better understand the impact of district initiatives on individual students or sub-groups.

Research on effective schools, including the research fueling second wave restructuring reforms, argues that careful monitoring, analysis, and discussion of student progress and program quality are central to improving education. Such monitoring, analysis, and discussion requires that:

- districts collect data on students and their educational experiences,
- data is accessible in a form that can be manipulated, and
- educators have the necessary tools to manipulate that data for fruitful analysis.

School districts collect a wealth of information about students and their academic performance. Much of this data, however, is dispersed throughout the district. Some data is in the central office main frame computer and is used for operational decision-making. Some data is in individual student files located in schools. Still other data can be found in other offices -- subject area supervisors, guidance offices, program administrators, etc.

This dispersion of data is a key factor limiting the usefulness of student data. Other limiting factors include the inability to integrate the various data kept in different forms, and the lack of analytic tools with which to manipulate and interpret data. Moreover, standards are ill-defined. Most districts do not have specific indicators of educational and instructional expectations for programs, teachers, and students.

Administrators and teachers alike know that improving the quality of eduction requires additional information about the impact of education programs on student experience. They know they need something better than averages, rates, and percentages to help guide curricular and program review. Summary statistics, a product of an earlier age of office and scoring equipment, will no longer suffice.

The 1980s have brought the emergence of computer technologies which are flexible, versatile, relatively easy to program, and relatively inexpensive. These technologies have brought decision support systems to large and small organizations. These technologies are being used by the Wissahickon School District in the financial area. We propose to begin to use them in the instructional areas. These contemporary and developing technologies - in computers, scoring equipment, and in understanding both quantitative and qualitative data -- provide us with access to better data while enabling us to develop better analytic techniques to examine a range of program and curricular issues.

To this end, the Wissahickon School District and the University of Pennsylvania Graduate School of Education's Center for School Study Council decided to collaborate in a project to develop ways for administrators and teachers in the district to more clearly analyze the impact of district initiatives on student experience.

Educators' Traditional Use of Data

Data collected by school districts has primarily been used to address problems of particular students or to satisfy federal, state, and local reporting requirements. These reports typically require use of summary statistics: numbers of students meeting certain requirements, norms and average test scores, attendance rates, etc. Much of this data is available in machine-readable form, structured to meet reporting requirements. But computer reporting formats, once set, do not permit the flexible manipulation needed for ongoing and careful analysis of student experience.

Moreover, a reliance on summary statistics such as norms hides more than it reveals. For example, Figure 1 presents four tables of possible data on ten students. For this example, let's imagine that "X" represents scores on a math achievement test and "Y" represents scores on a reading achievement test. A quick scan of the data suggests the variability of student scores.

Figure 1[1]

1		2		3		4	
X	Y	X	Y	X	Y	X	Y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

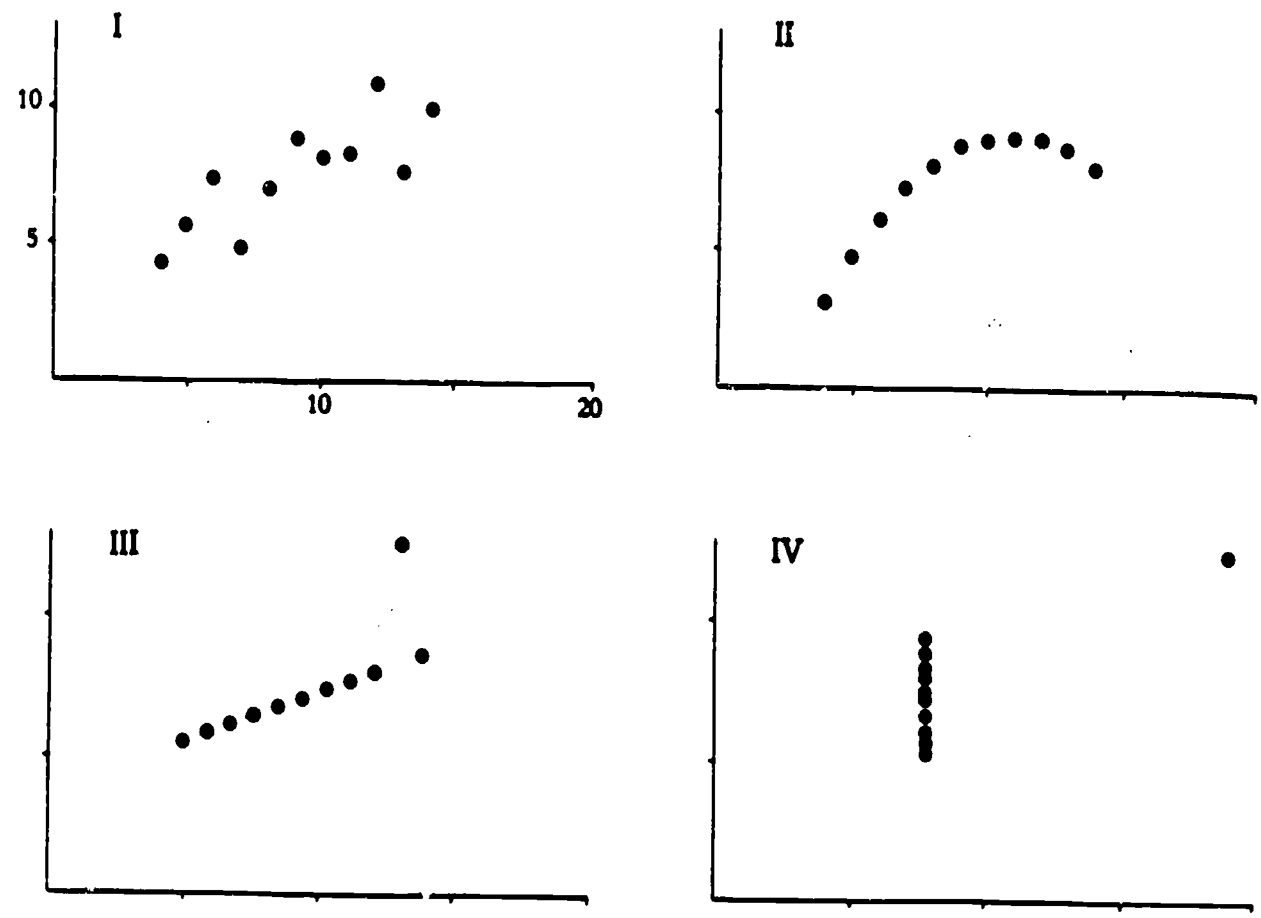
Yet, as Figure 2 indicates, the summary statistics -- means, the regression line, the correlation coefficient, etc. -- for all four tables are identical. Attention to such summary statistics would, then, mislead one into believing that all four groups of students are similar.

Figure 2[2]

N = 11
mean of X's = 9.0
mean of Y's = 7.5
equation of regression line: Y = 3 + 0.5X
standard error of estimate of slope = 0.118
t = 4.24
sum of squares X - X = 110.0
regression sum of squares = 27.50
residual sum of squares of Y = 27.50
correlation coefficient = .82
r2 = .67

Alternatively, Figure 3 dramatically reveals the variety of student experience of the four sets of data in Figure 1. Analysis of those graphs suggests the need for different kinds of interventions in each case.

Figure 3[3]



The need, therefore, seems obvious for the development of a system which permits educators to graphically represent student experience in order to effectively reveal individual, sub-group, and total group relationships. This project is unique in that it brings graphic display capabilities to the analysis of achievement and demographic variables.

Proposed and Projected Use of Data

The next step is to develop techniques of representing available data in ways that support more careful analysis. These techniques must enable administrators and teachers to raise questions about:

- the general population;
- specific sub-groups which emerge so educators can understand the performance of a student or group of students; and
- aspects of program offerings for specific students or groups of students.

The Technique: "Display Analysis"

The techniques we have developed fall under the rubric "display analysis." "Display analysis" consists of a number of techniques for displaying one or more variables for a target population. These displays enable educators to analyze the fit between programs, the pupil population, and various sub-groups. Further investigation is then possible using additional data -- including the personal knowledge staff have of students -- to better understand student progress. (See Figures 4, 4-A, 4-B, 4-C, 4-D.)

Even a very cursory analysis of these five charts provides very interesting and important questions. As examples:

- Why is there a greater variability in the relationship of GPA and Achievement Test results for males (Fig. 4-A) than females (Fig. 4-B)?

- Why does the White sub-population show a greater tendency to vary in the direction of higher achievement score in relation to GPA (Fig. 4-C)?

- Why does the Black sub-population show a greater tendency to vary in the direction of higher GPA in relation to achievement scores (Fig. 4-D)?

- What is the experience of those students who have done so well in one measure and average or less in the other (Fig. 4)?

Display analysis offers the opportunity to visually recognize these experiences, to ask questions about them, and to pursue answers based on individual experience rather than an average of those experiences. These figures are intended to serve as examples and are, therefore, relatively simple. Even in this form, however, educators in the pilot project spent several hours analyzing them and developing questions for further study. The number and kind of such displays are limited only by the data in the file and the ability to ask questions.

Analysis Leading to Interventions

It is important to realize that "display analysis" does more than answer questions. It raises questions and, in the process, supports the development of inquiry activities. By enabling educators to list and to graph student data on criteria the educators select, it reveals patterns -- i.e., clusters of students as well as exceptions. Display analysis equips educators to see that one or more students who are similar on some educationally relevant criteria, are divergent on other important criteria. In these and other ways, it supports developing inquiry strategies to discover "critical issues," district specific variables or indicators that account for similarities and disparities in student experiences. These critical issues are first steps in developing educational improvement interventions.

Figure 4

Relationship of Grade Point Average (GPA87) to Percentile Score on Total Battery (PR16) of Metropolitan Achievement Test for Selected Student Population.

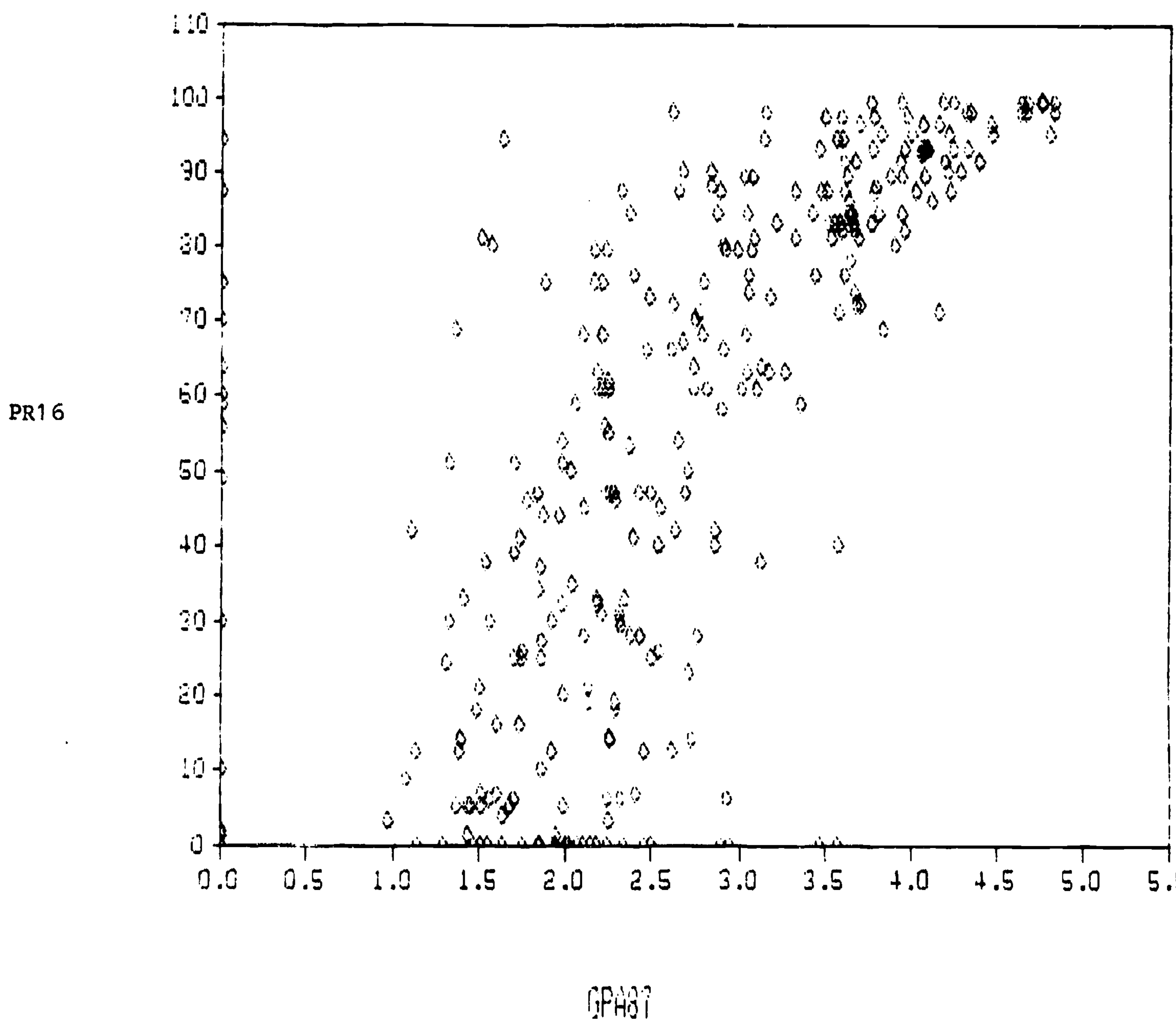


Figure 4-A

Figure 4 for Male sub-population.

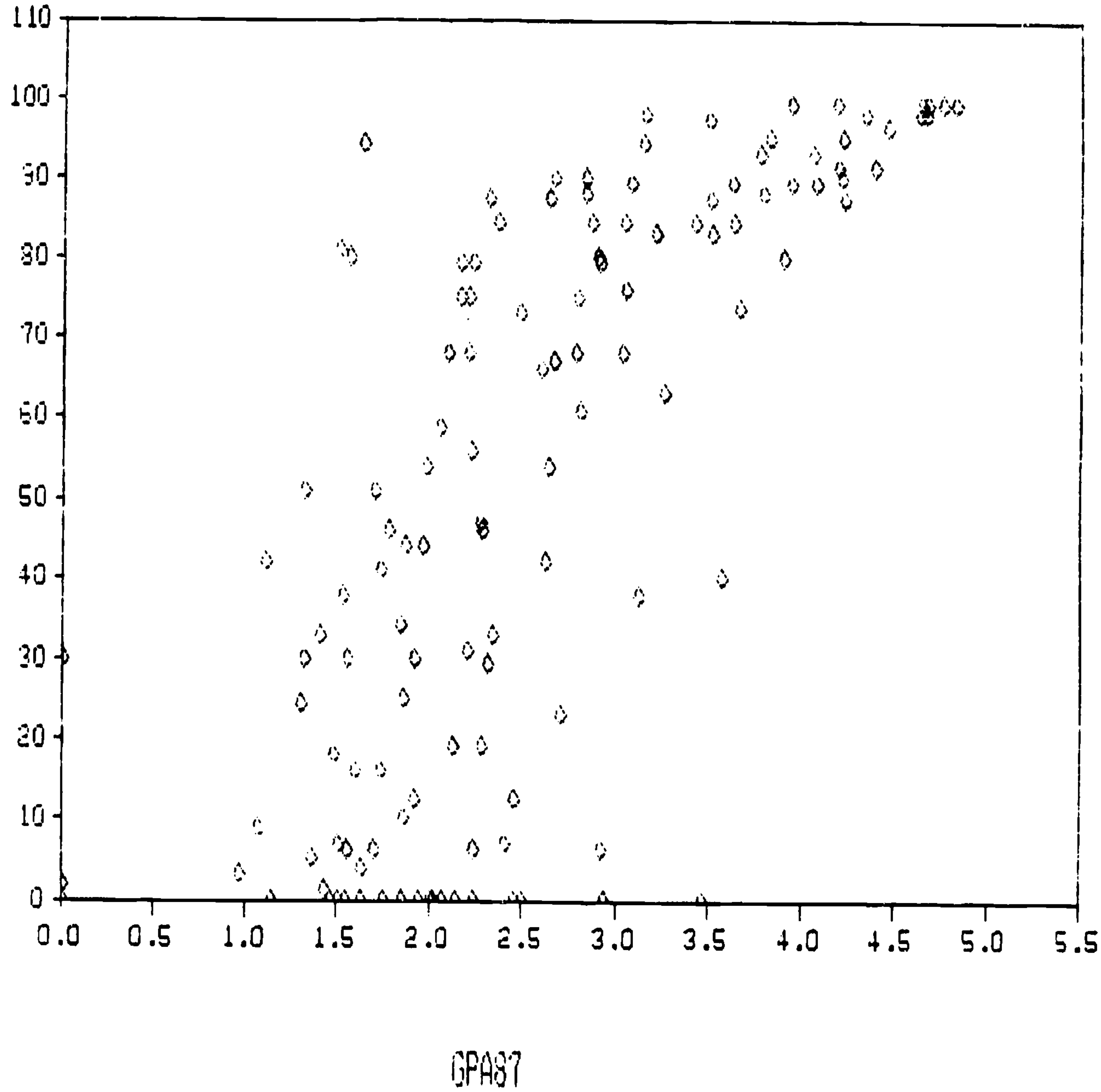


Figure 4-B

Figure 4 for Female sub-population.

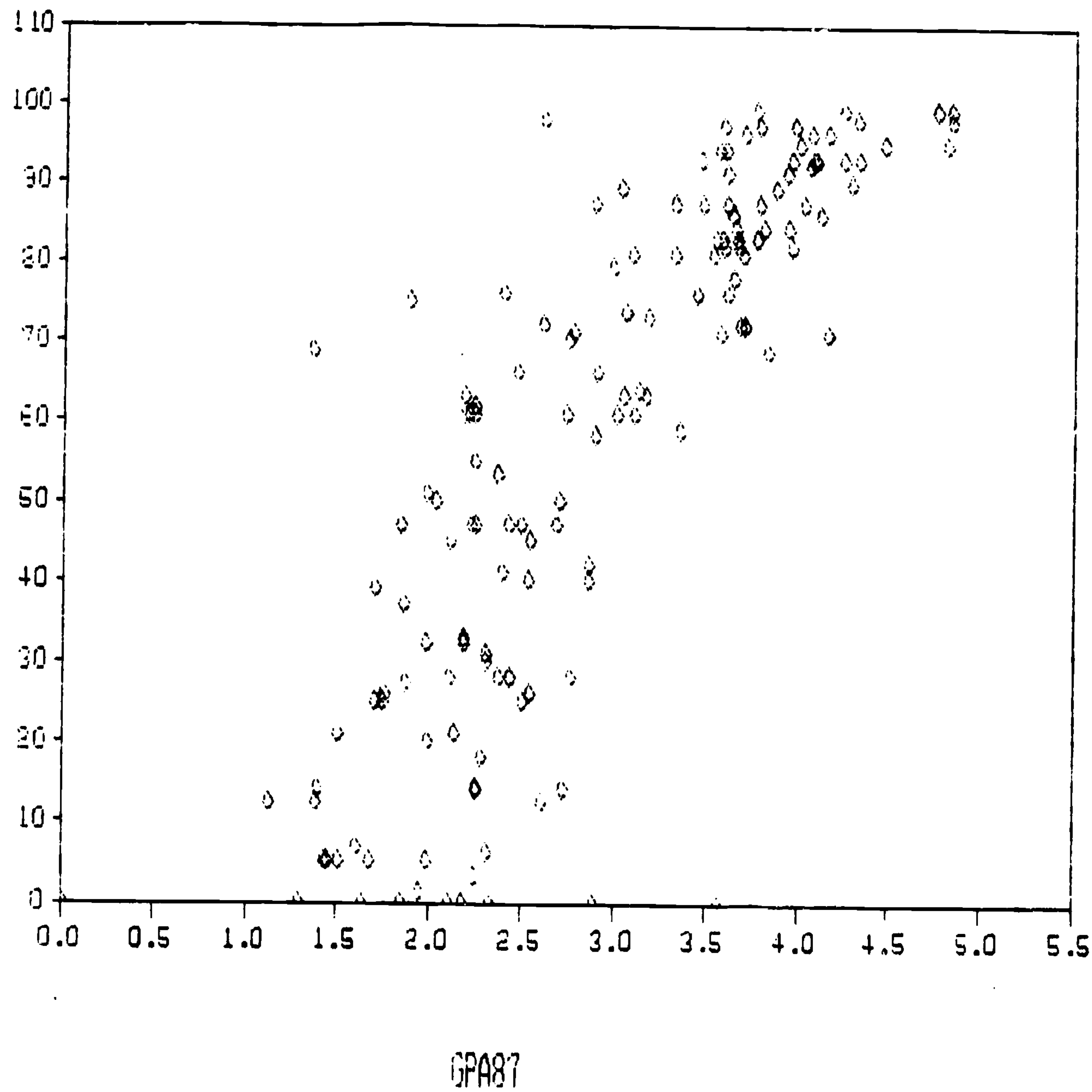
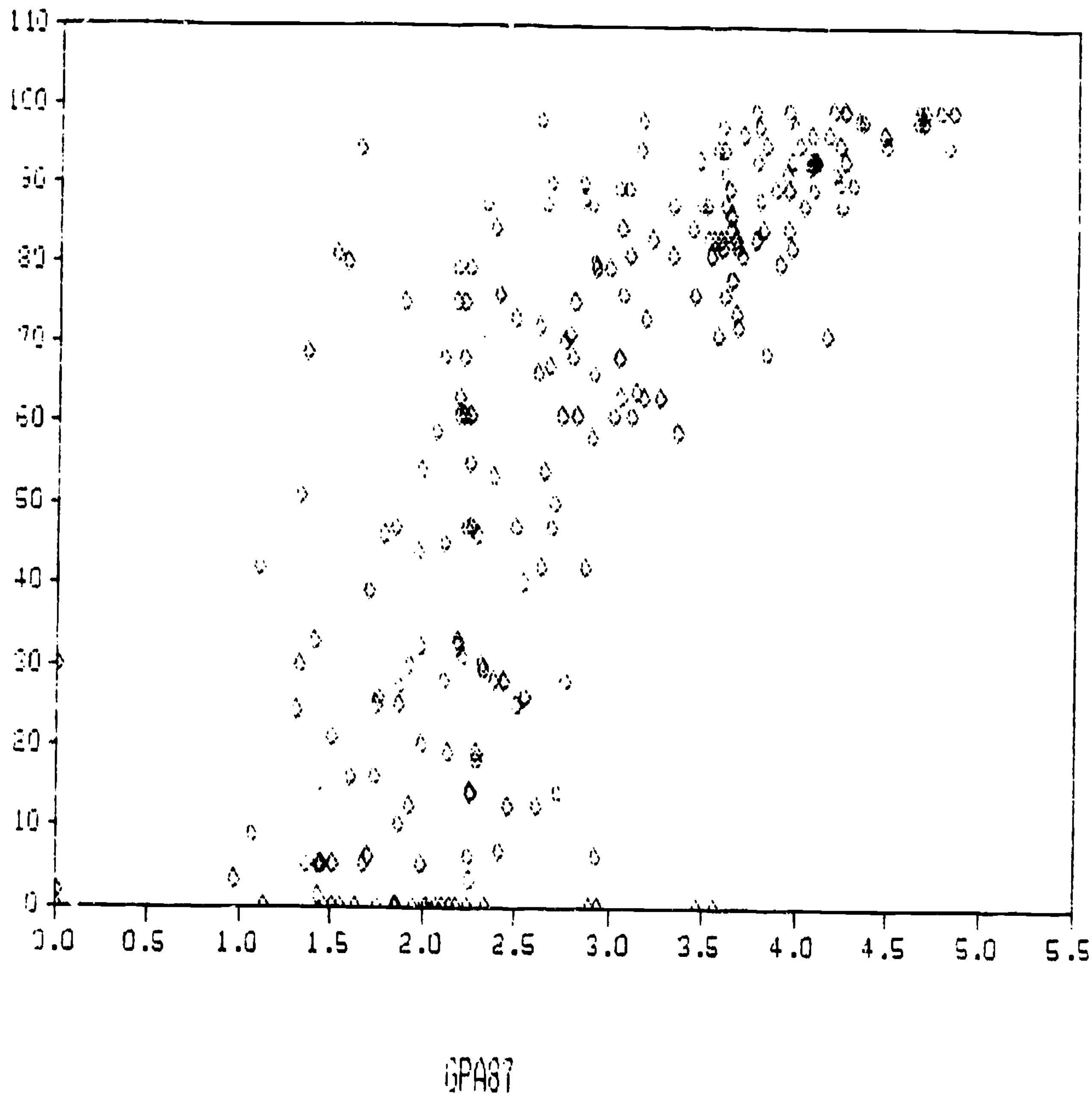


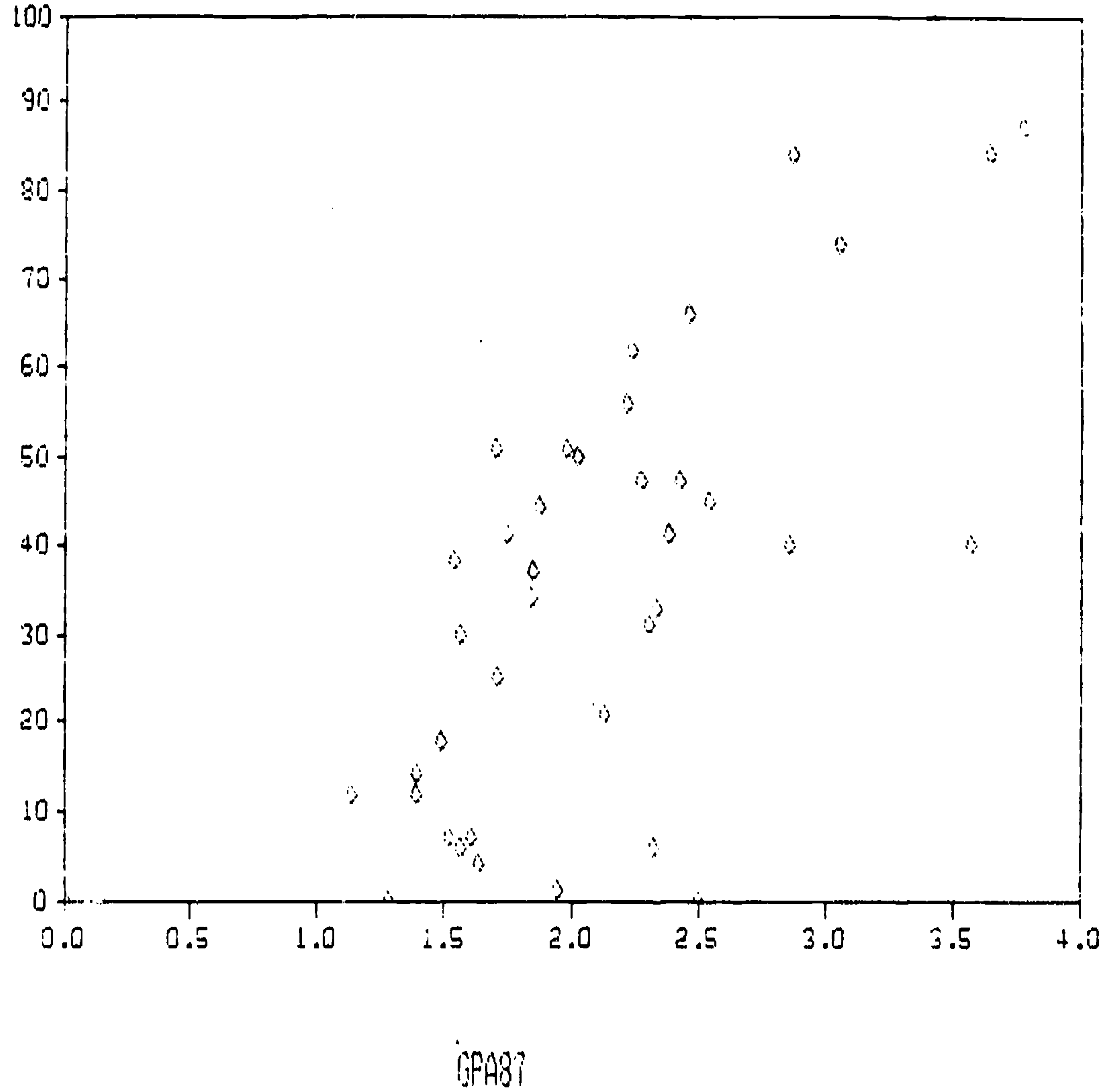
Figure 4-C

Figure 4 for White sub-population.



Fi<u>gure 4-D</u>

Figure 4 for Black sub-population.



The Need for Training

But the use of these tools i· not intuitive. Educators who have become accustomed to discussing means and norms need help refocusing their attention to patterns of individual scores. Educators who have become accustomed to providing statistical answers need help developing skill in using statistics to raise more probing questions. Thus, in addition to developing the longitudinal student database, we are continually developing and refining tools to analyze data on student educational experiences. We are also developing model inquiry strategies that lead to educational interventions.

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CONCLUSION

We have developed a flexible and responsive computing environment. Success is understood in terms of the actual use of the system in individual and organizational decision making. Our next step is to work closely with district staff on the kinds of data analysis and reports they requested. In the process, new needs will emerge as they modify their requests as they begin to explore the data with us.

Our successes to date have been built upon our ability to respond quickly and flexibly to questions and suggestions. Work sessions are interactive, where participants see, act, and react to system structure and output. This enables users to follow-up a line of interest and to leave the session with information to apply as is to actual work activity. This also teaches problem-solving techniques to all participants. The project team plays a crucial role in teaching users how to manipulate the technology to keep up with the imagination and in raising problem questions.

Developing these new perspectives requires a great deal of individual and organizational learning. We have seen that, once the usefulness of individual student data, aggregated at various levels, is understood, it becomes a powerful means of generating probing questions about program structure, content, and outcomes.

We expect that the system will be refined as new uses are developed. Thus, new kinds of data will be added, new ways of presenting that data will be developed, and reporting forms will be designed to meet the ongoing and evolving needs of users.

Finally, it appears that the disaggregation of data, combined with the flexibility of data manipulation in a graphic presentation offers tremendous potential to help the practicing educator better understand the experience of students. Attempts to explain student experience have encouraged educators in this project to develop better inquiry and analysis skills. There is a high degree of awareness by project participants that there is less likelihood that students will be "lost in the data shuffle" using the display analysis technique. Most importantly, educators in the project feel empowered for the first time to purposefully utilize the available student data, to analyze it and make sense of it. The greatest promise in the project does not lie in the answers which we have developed, but rather in the ever improving quality of questions. Regardless of the data available, the value of the process is only as great as the insights and questions brought by the project participants. In that regard, we believe that we have experienced success, and that the potential for further development continues to increase.

FOOTNOTES

[1] Tufte, Edward R. The visual display of quantitative information, Cheshire, CT: Graphics Press, 1983.

[2] *Ibid.*

[3] *Ibid.*